2-2010

When Difference Hurts: Technology Space Activity and Failure

Anindya Ghosh
University of Pennsylvania

When Difference Hurts: Technology Space Activity and Failure

Abstract
This paper investigates failure of startups due to their accumulation of intellectual property rights (IPR) in the context of the wireless telecommunication industry, here framed as their technology space - a space that we constructed through shared technology. Obtaining intellectual property rights forms an important signal for startup viability but only to a limited degree, compelling us to posit a U shape relationship between failure rate and IPR flow. The location of startups in the technology space, and the associated signals that come with that location presents powerful information regarding their failure rates. Disclosing intellectual properties erodes the benefits of secrecy and innovative lead time as deference (as proxied by patent citations) by peer to new firms increases their hazard of failure due potential competition and harmful spillover effects - particularly if the sector manifests a weak appropriability regime. Technology concentration of the deference is also found to be harmful; however the interaction of the two is positive. This leads us to infer that startups with specific and focused technology acknowledged many other firms or those with general but deferred to by few others have better possibility of stemming the rot.

Keywords
technology space, failure, wireless, technological innovation, entrepreneurship, IPR strategy

Disciplines
Other Business | Technology and Innovation

WHEN DEFERENCE HURTS

TECHNOLOGY SPACE ACTIVITY AND FAILURE

Anindya Ghosh & Johannes M Pennings

The Wharton School

University of Pennsylvania

Philadelphia PA 19104

February 2010

DO NOT CITE

WHEN DEFERENCE HURTS

TECHNOLOGY SPACE ACTIVITY AND FAILURE

A STUDY OF HI-TECH VC-BACKED WIRELESS STARTUPS

ABSTRACT

This paper investigates failure of startups due to their accumulation of intellectual property rights (IPR) in the context of the wireless telecommunication industry, here framed as their technology space - a space that we constructed through shared technology. Obtaining intellectual property rights forms an important signal for startup viability but only to a limited degree, compelling us to posit a U shape relationship between failure rate and IPR flow. The location of startups in the technology space, and the associated signals that come with that location presents powerful information regarding their failure rates. Disclosing intellectual properties erodes the benefits of secrecy and innovative lead time as deference (as proxied by patent citations) by peer to new firms increases their hazard of failure due potential competition and harmful spillover effects - particularly if the sector manifests a weak appropriability regime. Technology concentration of the deference is also found to be harmful; however the interaction of the two is positive. This leads us to infer that startups with specific and focused technology acknowledged many other firms or those with general but deferred to by few others have better possibility of stemming the rot.

Keywords: Technology space; failure; wireless; technological innovation; entrepreneurship; IPR strategy

INTRODUCTION

"Intellectual property portfolios are the lifeblood of many wireless tech firms. But patent disputes can cost millions of dollars to defend and take years to resolve"

- Cover Story, Wireless Week, August 15, 2005

We observe a peculiar split in the literature regarding technological evolution and firm survival. On the on hand some authors address the failure of large established firms that bring along the baggage of their legacy technological platform as the sector endures some major disruptions (Hannan and Freeman 1984; Tushman & Anderson 1986; Christensen and Bower, 1996; Henderson 1993). On the other hand many other studies explore the success and failure of firms, whose technological platform coincides with the stage of their sector's technological evolution and where quality of new firms are signaled reasonably through the granting of intellectual property rights with concomitant endorsements from incumbents (Stuart, Hoang & Hybels, 1999; Hsu & Ziedonis, 2008). Affiliation with prominent third parties is shown to have important certification benefits diminishing the odds of failure and improving the chance of going public. Patent grants have positive effects on valuations obtained during financing thus establishing their importance as signals of quality. The present study tries to add to these literatures by focusing on a context where discontinuous technological changes are managed by incumbents and where disclosure and endorsements might have important costs that outweigh their benefits, especially in the technology domain.

The appropriability regime of a firm's sector conditions its technology strategy (Levin, Klevorick, Nelson, Winter, 1987; Cohen, Nelson & Walsh, 1994; Klevorick, Levin, Nelson, Winter, 1995). The sector that is the subject of this paper, wireless and mobile communication is characterized by use of trade secrets and lead times in innovations, which far outweigh patenting, and the disclosure of intellectual property as a signaling mechanism might be fraught with harmful spillover and imitation, not to mention the threat of potential, very costly patent litigation, as highlighted in the opening quote. The same holds for third-party certification, especially endorsement by prominent firms who not only control important complementary assets like customers and distribution but also enjoy an undue hegemony around the shaping of technological direction and dominant designs. This is especially true for the wireless and mobile communication industry where operators like Verizon and Vodafone control the end users and vendors like Nokia and Qualcomm define the technology platforms.

In the following parts of this paper we first develop theory and testable hypotheses. We provide a description of the empirical setting and brief history of the sector. Next we describe the dataset, analysis, and results. The main research question addresses the effect of a new venture's technological conduct on failure rate in a sector that is highly contested and dominated by major competitors along the value chain. Any nascent firm in this sector faces the dilemma of signaling technological advancement and enhanced certification at the cost of reverse engineering or infringement claims that are product of a poor appropriability regime. While intellectual property grants can be construed as milestones that confer legitimacy to a startup they also expose the firm to spillovers and imitation, resulting paradoxically in trade secrets and non-disclosure as a more favorable avenue in securing a competitive technological advantage. We conclude by making some inferences about the results and future path.

THEORY AND HYPOTHESES

The technology strategy that a startup pursues hinges on the conditions in its domain of technology. The intellectual property rights (IPR) strategy assumed by a firm depends very much on the appropriability regime (Teece, 1986) in that domain as well as on the direction and velocity of its technological trajectory. The pertinent literature is replete with highly visible framings of its history including the rise and fall of a dominant design (Utterback, 1994), incremental and radical innovation (Tushman & Anderson, 1986; Henderson & Clark, 1994), core change (Hannan and Freeman, 1984) and disruption (Christensen & Bower, 1996). Many empirical studies underscored the role of discontinuous innovations in toppling established incumbents. Invariably they impute an unmanaged evolution as in organic life forms. Other studies, however, imply some visible (Cusumano, Mylonadis, Rosenbloom, 1992) or invisible (Van de Ven and Garud, 1994) hand in driving the speed and direction of technology, and suggest that its trajectories are shaped through formal standard setting and collusive practices. The wireless sector is one such area of activity, where regulatory bodies, standard setting consortia and the market power of large firms render the sector checkered and gradual in its development. Finding an optimum strategy in such an "technology space" is most challenging, especially for small new entrants.

Startup Technology Space

We conceptualize technology space as the network formed between firms through sharing the same technology activity over the course of the sector's history. Since there is a strong incentive to innovate in similar and incremental technologies a pronounced core/periphery distinction is to be expected. Attempts at radical innovations reside at the periphery while those that conform to prevailing norms and practices occupy central positions. Concurrent with the aggregate evolution, startups build up their technology platform and try to establish their legitimacy and so disclose their intellectual property incrementally. We believe that in doing so they endure their technological edge as a double edged sword: depending on the balance they fail or survive. In the following paragraphs we elaborate.

IPR as Signal

In the absence of credible, established track records, startup firms signal the underlying value of their venture to investors and other stakeholders. In their study on semiconductor firms, Hsu & Ziedonis (2008) show that IPRs significantly determines venture valuations, ceteris paribus and fosters the likelihood of sourcing a prominent VC in the first funding round. Their semiconductor sector also exhibits an unfavorable appropriability regime. If the filing and granting of patents confers such positive signaling benefits, we should expect in our setting likewise IPR's to perform and important signaling function in attracting new investors and convince existing promoters of its viability. However, this benefit of growth in IPR does not accrue monotonically. Instead we should anticipate decreasing returns to R&D output as investors and other stakeholders update their evaluation of quality over time. Patenting is not only costly but also is afflicted with unwanted and harmful spillovers and imitation.

We therefore hypothesize:

H1. The yearly flow of patents granted to a startup has a U-shaped relationship with its hazard of failure

Distance in Technology Space (Core/Periphery Structure)

A sector characterized by a core-periphery structure, a putative directionality in technological developments and widely shared, established industry standards reward startups that innovate in its core technologies. The case of ComSpace Corp, a Texas based company that received $26 million in equity financing from the likes of Sevin Rosen Funds and Noro-Moseley Partners illustrates this trend quite convincingly. It owned about 20 patents, which allowed an eightfold amount of traffic to be carried over existing radio channels. Called Digital Multicarrier Architecture -- DCMA for short – the technology also handled data, meaning it could be used for wireless access of the Internet, short-text messaging, e-mail and video. However, DCMA in spite of sharing a nearly identical acronym with Code Division Multiplex Access (CDMA), one of the core technologies standardized by industry incumbents, but not occupying a location in the core of wireless technology quickly vanished from the sector.

Thus, based on this cursory discussion we predict:

H2. The location of a firm in terms of closeness centrality in the technology space lowers its failure hazard rate.

Deference in the Technology Space – From Whom

Once a startup discloses its production of intellectual property, other firms grant deference by acknowledging its R&D output as prior art. The act of deference is deemed beneficial and when revealed by prominent alters confers status (Podolny 2005). This argument assumes no costs to the actor receiving the deference. While this is generally true in social settings where ambiguity abounds, given the nature of our context, disclosure is costly since its exposes the startups to imitation and other forms of appropraibility. This drawback of deference poses a challenge to the startup, especially when they originate from other firms rather than individuals. Continuing the example of ComSpace, its technology received the attention of industry giants such as Marconi, Ericsson, Sony and Nokia, which however did not have licensing agreements with ComSpace. An exception was a Hitachi business unit which did license. The higher the number of firms that acknowledges a firm's IPR, the more difficult is it for its owner to monetize it into revenue producing licensing agreements. Given the additional threat of litigation from powerful players in a highly contested domain the threat of failure is exacerbated when high levels of deference make it difficult for a start up to manage its R&D portfolio. .

We therefore posit:

H3. Failure hazard rate is positively associated with the flow of deference a starup receives from peer firms.

Deference in the Technology Space – Technology Concentration

The generality of a firms' technology is determined by the diversity of domains it receives deference from. A more general purpose technology will likely have more applications than a firm that restricts itself to a narrow range of technology. Some startups thrive by search for applications outside its sector even if proximate industry peers shun them. Whether a startup's technology platform is general or specific can be inferred from the breadth of technology citing its IPR as prior art. Danger Inc., the creator of the Sidekick illustrates this case when they sold themselves to Microsoft where their current objective is to build great, intuitive client software for mobile handsets connected to hosted back-end services rather than their initial focus creating specific wireless devices themselves. Therefore a firm's chances of avoiding failure grows if its technology enjoys wider appeal, the acknowledgement of its R&D output is dispersed over a wider audience of peers, while firms with a very specific technology, as inferred from the diffusion or dispersion of its audiences technology domains, are prone to failure which leads to the next hypothesis:

> *H4. The higher the concentration of deference flow that a firm receives, greater is the failure rate.*

Deference in the Technology Space – When Does it Hurt?

Based on our arguments on the number of deference received, and the technology concentration imputed in the above paragraphs we can deduce that a focused startup is better capable to contain spillover and in policing its IPR portfolio. Similarly, it will easier to handle a general purpose technology if fewer peer firms recognize its prior art. By contrast, a comparative large technological audience with a general purpose technology is very challenging for a startup to cope with. Thus we predict an interaction effect:

> *H5. The interaction between the concentration of deference flow and the flow of the number of peers' acknowledgements is negatively related to its failure hazard rate.*

METHODS

Research Setting

We conducted this study in the wireless sector and focus on venture funded startups in the US. Wireless or mobile communication is chosen since the appropriability regime is relatively weak as required by our theory. Although the firms are located in the US, their scope is global. Wireless is a global industry with multinational firms such as Nokia, Ericsson, Qualcomm, Samsung, Motorola, T-Mobile and Vodafone dominating the competitive landscape. Although the sector has a very complex value network with a variety of corporation as illustrated in figure 1 (Camponovo & Pigneur, 2002), it is dominated by the network operators and the vendors of equipments and handsets.

Insert Figure 1 about here

The high growth potential and variety of opportunities across the value network due deregulation and technology changes have spurred a high level of startup activity. These activities have been global although dominated by US based firms as shown below. Next the history of the sector is briefly reviewed.

Insert Figure 2 about here

Brief History of Wireless 1990-2009

Wireless has experienced tremendous growth since the early nineties with the introduction of digital technologies in cellular systems. The introduction of GSM (Global System for Mobile communications) in Europe in 1991 was a fundamental driver made possible through a wave of technological, institutional and market innovations. Although there was inter-regional heterogeneity, these so called 2G (second generation technologies which were all digital) cellular technologies kick started the innovations that received a lot of attention and money from venture capitalists through the boom and bust of the Internet, peaking in 2006. While cellular technologies anchor the wireless arena, the innovations in the sector are not just limited to them. Wi-Fi, WiMax, Bluetooth, UWB, ZigBee, GPS and RFID represent some of the other technologies that were developed and financed by investors. Figure 3 and 4 below illustrate the relationship between the various technologies classified according to two dimensions, the coverage area and bandwidth. These two dimensions are a function of the frequency spectrum used by the technology and limited by the physics of that space.

Coverage area is determined by the distance the waves propagate and the ease with which they penetrate dense obstacles like walls and trees. The bandwidth determines the maximum information carrying capacity of the medium and is conditioned by the energy that a signal can carry which is limited by the spectrum space, technology and regulations. A unifying force behind all these technologies is the trade-off between coverage and bandwidth that has led to the need for co-existence among these technologies as no single wireless technology can fulfill all the demands of wireless applications. This has become extremely important with the introduction of data services on cellular systems with the transition to data focused 2.5G and 3G standards starting at the turn of this century. Voice, the predominant application of cellular system, is poised to become one among many data applications with varying bandwidth needs. Another significant effect of this movement towards data is that technologies in software, applications and content for wireless have received a lot of attention. Thus the traditional concentration on components, equipments, systems and management software has been complemented with spot on software, applications and content for mobile data services.

Wireless Startup "Technology space"

Several authors have tried to categorize the technology space and the European Patent Office even provides an IP "web-guide" by country, scientific field and other classes. In this paper we construct the technology space by dint of a time invariant network of US startup firms founded between 1990 and 2009 whose accumulation of intellectual property becomes spatially tied to that of other firms through shared IPC technology classes. In other words, technology similarity is captured through shared technology classes and is used to capture the core-peripheral structure of this field. We used Derwent, a database of patents maintained by Thomson to collect patents of all the startups in our sample and the assigned IPC codes. We use Derwent because it is a database of global patents. Since the ambit of activity of our startups is international in nature, using Derwent is more appropriate than using the USPTO database. Figure 1 shows the startup technology space. We can clearly see the core-periphery structure as posited in the section on theory.

Insert Figure 5 about here

Data & Sample

We test our theory using the population of all firms in the US wireless and mobile communication sector that were founded between the year 1990 to 2009 and received at least one round of early stage VC funding. There are 428 such firms as documented by VentureXpert, the leading source of information on Venture Capital from Thomson Research, commonly viewed as the most comprehensive and widely used database for research on venture funded companies. We classify startups as wireless firms using the Venture Economics Industry Classification (VEIC) of Thomson with those residing within the VEIC codes of 1300-1399 range. We supplement the VEIC code with a Standard Industry Classification (SIC) code from SDC Platinum, Hoovers and CorpTech. The data for this study came from a variety of sources. While the main information on our sample on firms, including their their financing and products came from VentureXpert IPR information was obtained from Derwent, a database of global patents maintained by Thomson since 1969 and frequently used previously in strategic management research (e.g., Henderson & Cockburn, 1994; Eggers, 2008). The Thompson IPR database provided much better coverage for our sample of firms (more than 25% firms have patents when compared to the USPTO) because of its global reach. Other data related to alliances were collected from three different archives, SDC Platinum, Factiva and the historical websites using the Wayback machine (http://web.archive.org). For Merger & Acquisition & IPO data we used SDC, Zephyr, Factiva and Hoovers primarily. Finally COMPUSTAT was accessed for segment data on wireless firms which are in the public domain.

Dependent Variables

Table 1 provides definitions of all the variables used in our analysis. Since we are using a competing risk model of either a successful or failed outcome, we identify these outcomes and create firm-year spells from founding to outcome or censoring at the end of 2009. We identify firms that were liquidated as outright bankrupt or were acquired in a distressed sale (dummy variable *Failures*) in the year of exit. Those that experience an IPO or were acquired are flagged as successful firms (dummy variable *Successes*) in the year of the event. We model the hazard rate using the time to either of these outcomes experienced by the firm from birth.

Insert Table 1 about here

Independent Variables

Patent Grant Flow is a variable that captures the number of patent granted to a firm in a given year and signals to its audiences the creation of property . We capture its location in the technology space by calculating the closeness centrality in a network constructed through shared IPC classes. The variable *Closeness centrality in startup technology space* captures its peripheral to core position, with increasing value from 0 to 1. This metric is time invariant over the widow of study.

Deference is measured with an annual count variable, *Patent Cite Flow by Firms*, which is the number of forward citations received by the firm from peer organizations in a given year.

Finally, we quantified a firm's annual audience diversity as the inverse of the heterogeneity in forward citations received. That diversity is captured by the Hefindahl index of IPC classes associated with patent classes of firms which cite the focal startup's newly granted IPR. We surmise that the startup's peers as competitive audience which mention the startup's patents and which belong to a relatively narrow band of technologies, its IPR should be viewed as very focused and specialized. The variable *Concentration of Fw Cite Flow, by* computing the sum of the square of the share of each of the IPC classes of the patents citing the firm.

Control Variables

Obviously we ought to hold many factors, associated with entrepreneurial firms, constant that others have identified as shaping the viability and eventual success or failure among new ventures. These controls can be categorized in five broad categories. First, related to IPR we include the stock of patents granted and forward cites received . We also control for the total flow of forward cites, signaling the aggregate value of a startup's IPR. The second category controls for exit market conditions that either constrain or embellish a startups outlook. . The intensity of annual IPO activity in a startup"s four digit defined industry as well as the annual incidence of acquisitive activity inn that industry is computed. The third group of control variables holds investor characteristic constant. These include the number of investors, whether the investors are corporate venture capitalists and the number of investors who invest in all rounds of financing. These controls are often deemed important in moving a new venture beyond the adolescent stage. Fourth, related to the financing received, we control for the number of financing and time to the first date of VC financing. Finally, the fifth category includes so called corporate development actions, i.e., namely strategic alliances and acquisitions. We also included a control variable at sector level, growth using total sales per year of all business segments that publicly quoted wireless operators and vendors operate in and entry year of the startup i.e., left censoring in the event history model.

Method

We use a competing risk Cox proportional hazard model (Lee & Wang, 2003) of the wireless startup outcome rate. The idea of the competing risks model is to let the hazard rate vary with the end state. In the framework of a competing risks model, the duration corresponding to the state not realized is truncated. From a methodological point of view, this implies that the realized state will contribute to the likelihood function via its density function, while the truncated state contributes to the likelihood function via its survivor function. Competing risks models focus on both the type of exits and time to exit (duration). In contrast, a Logit model for example would only focus on the type of exit (binary choice) and the likelihood function of a Logit model would not take into account the time variable (compare JBF, 2005). The regressions were computed using the stcox procedure of STATA.

RESULTS

Table 2 present the correlations and descriptive statistics of the variables included in the analysis. We ran diagnostics for multicollinearity using the Variance Inflation

Factor (vif) procedure after running an OLS regression in STATA and found no significant issues in spite of the relatively high correlation among several variables. On average fa irm in our study obtains one patent per year, received approximately four cites per year and exhibits a technology concentration (Herfindahl) of 12% among its forward citations. The average closeness centrality is 0.01 with a maximum of 0.02.

Insert Table 2 about here

The five hypotheses were tested by fitting a competing risk Cox proportional hazard model to the data as elaborated above. Table 3a & 3b presents the results for the two competing risks, failure and success. Our main hypotheses apply to the case of failure. We contrast these results with those involving to bolster the robustness of our inferences.

Insert Table 3a & 3b about here

The two tables show seven models that we fitted. Model 7 is the full model that we will use for our analysis. Hypothesis 1 posited a U shaped relationship between the failure hazard rate and the flow of patents received. This is strongly supported in model both model 6 & 7 in Table 3a with a negative main effect and a positive effect for the quadratic term. Thus the value of patents as signal hypothesis is corroborated Interestingly the case of successful outcome also gives moderate support (5% significance) to this thesis (model 7 Table 3b). The success rate is inverse U shaped with respect to patent grant. Thus in our view the benefits of signaling by a startup are important and outweighs the costs of disclosure.

H2 is also strongly supported in all the models in Table 3a, suggecting that startups fare better if they are central within the wireless sector, while those located in marginal locations face early exits . Paradoxically, Table 3b shows that it is a "non factor" for success. H3 is strongly supported in model 7 but only mildly in model 6. While cites by firms are harmful, total cites are beneficial. Also this variable has no effect for the case of success, once again showing that the mechanisms driving failure and success are very different. H4 is strongly supported in model (7). Diversity is conducive to reduced risk but is not conducive to IPO or acquisition—our outcome of success.. Finally H5 provides intriguing yet compelling evidence regarding the outlook of fledging ventures. Note the interaction effect of receiving wide IPR acclaim a revealed by forward citations and concentration of its technological audience (Herfndahl of peers' technology classes) The interaction effect on failure is negative and moderately significant while the same effect is weakly significant for the case of success,. The implication is that startups with high citation counts form a dispersed and diverse audience tend to survive without liquidity events, i.e. startups that some VC's have called "living deads".

The results obtained must be seen in the light of the limitations of the method. We tested for the violation of proportionality assumption of the Cox model. The global test failed. However the failure was accounted by just one control variable. Dropping that variable does not change the results. We will also do more robustness checks and fit competing risk models using a Mixed-Gamma distribution model in the future. We also did likelihood ratio tests between the models with quadratic and interaction terms to check for spurious effects. Perhaps leave this para out?

DISCUSSION

This paper has sought to break new grounds regarding the factors that account for the success and failures of new firms that entered a highly competitive, technologically intense, uncertain and fluid market dominated by two classes of titans, the handset producers and telecommunication carriers. While the setting is unique in many ways, the wireless sector shares certain characteristics with other industries, especially around the creation, accumulation and aprpropriability of intellectual property —for example semiconductors, computer software and imaging. In our setting we explored the entry of new ventures with new and future proprietary technology, whose R&D signals might contribute to the endorsement (Stuart et al, 1999) by venture capital firms, illustrating the two sides of the small fish in a big pond metaphor. Through future citations they receive feedback, if not status and further endorsement regarding their innovative performance. Yet they also expose themselves to the risk of knowledge theft, imitation, reverse engineering, litigation and even early exit.

We have shown that such new ventures endure significant risks when they disseminate their new technological inventions through patent filing to an audience that often comprises larger and older competitors in the very same industry. When that signal is highly focused and received by firms in the very same technological cluster or niche (Podolny and Stuart, 1995), as operationalized by future citations from a relatively homogenous set of peers, the startup often seals its own unpleasant fate, even if future citations in general convey positive feedback, and produce value to the firm.

Our study highlights the importance of patents as signal. We find the benefits of their use both in the case of failure and success. Thus, our interpretation is that IPR as signal for their underlying value in providing legitimacy outweighs endorsement of technology with concomitant risks of reverse engineering, especially in our setting where IP regime is not as strong as in Pharmaceuticals and Chemical. Since many high-tech industries share this characteristic, our results are generalizable to other settings—most notably other high technology sectors such as semiconductors. .

Perhaps the most compelling result of our study is the startup's generality of its technology. If its signals convey a general technologies exit is avoided, yet such strategy is not sufficient for success. The intriguing result comes from the interaction of the generality of the technology and the degree of deference received. In both successful and failed scenarios, firms endowed with narrow technologies combined with high levels of forward citation per year face a lower probability of either succeeding or failing, a condition that VC's often called living dead (Bourgeois and Eisenhardt, 1987). This state of "morbidity" obtains under conditions of small market growth or the appropriation of created value is difficult

Being a single industry study our paper requires the usual disclaimers of generalizability. Yet, the wireless industry represents the norm in high-technology when dealing with of the strength of appropriability regime, compared to other common entrepreneurial investigations such as pharmaceuticals or biotechnoly. Our methods can also be refined and made more robust., an issue we will address in the future.

While our study has produced some important advancements on entrepreneurship research, , many issues remain. . Clearly, the analysis hints at a range of signals, beyond technological innovation that startups emit, for example alliances with peers, staffing of key positions, personal networking, press releases (e.g., Pontikes, 2010) and marketing actions, such as the launch of new products or services. Finally, we stress two unresolved concerns. First, while the bulk of entrepreneurial performance confines itself to success and failure, we believe that such a simply dichotomy is misplaced. Like any set of comparisons, we encounter variations in performance. We noted a category called "living dead" which falls in neither the success nor failure category. Second, since the study by Stuart, Huang and Hybels (1999) is has become taken for granted that endorsement is a positive outcome for any fledging company and is framed as one of its most important intangible asset. Because our results call such a claim into question, we need to acquire a deeper understanding of deference as an implicit if not explicit endorsement behavior—which has become so central in the current research on markets as status systems (Podolny, 2005) and is fraught with endogeneity issues..

Figure 1. Wireless Actors Map

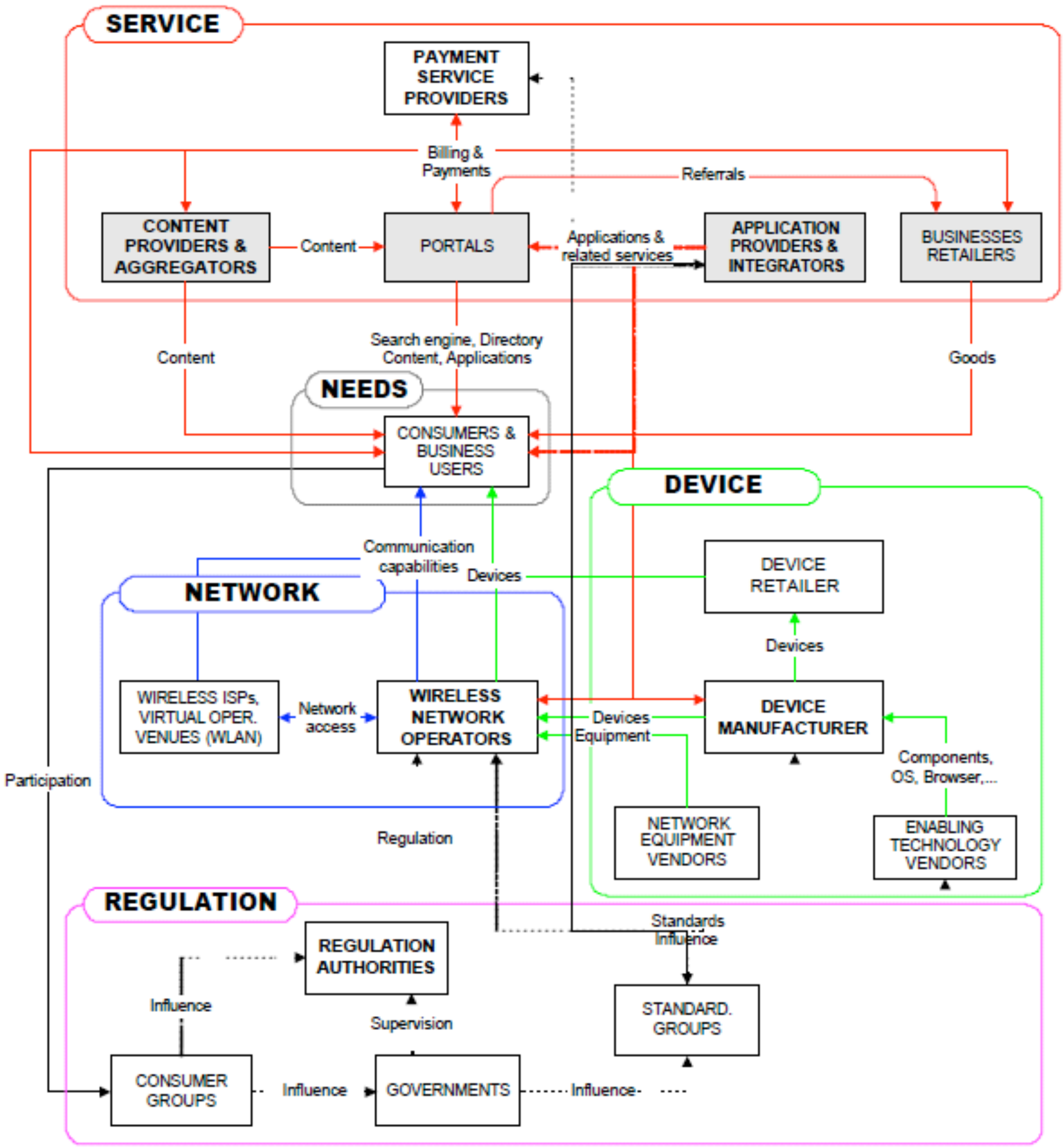

Figure 2. Global Wireless VC backed Startup Activity 1990-2009

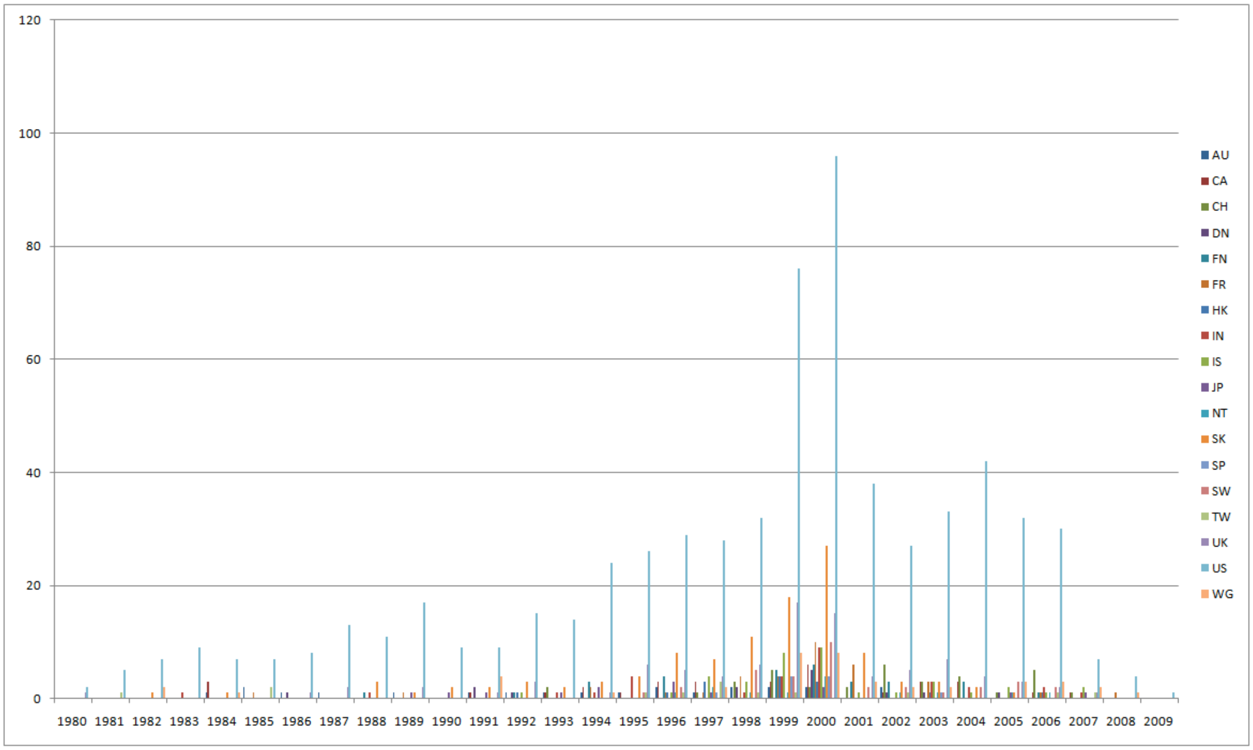

Figure 3. WirelessTechnologies

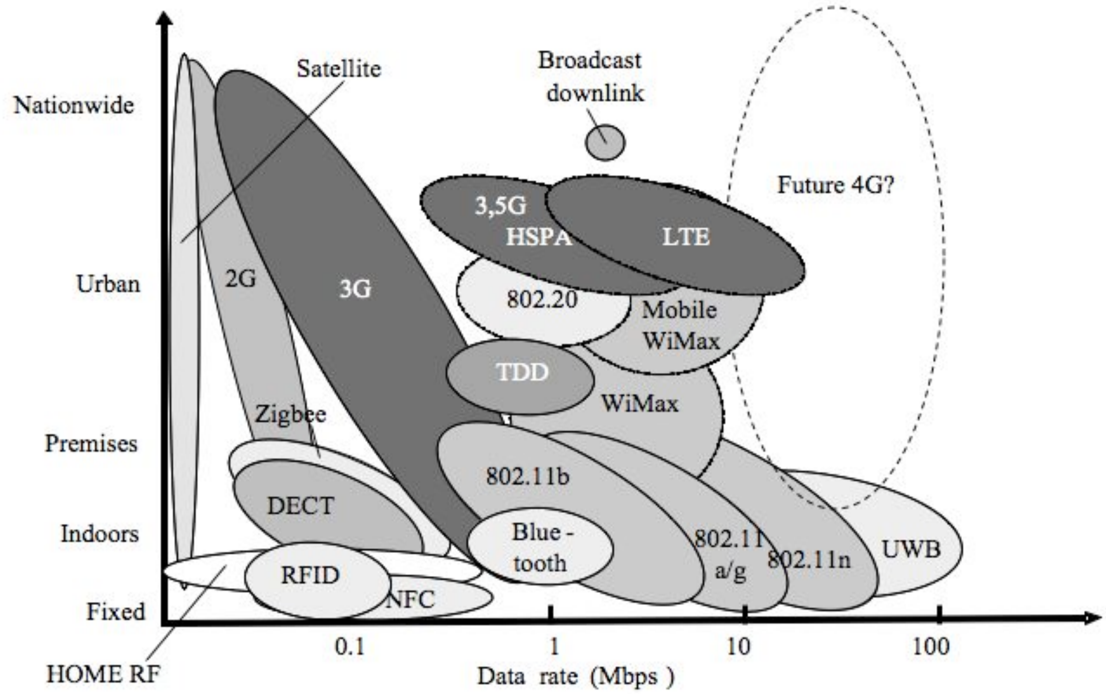

Figure 4. Bandwidth versus Coverage Tradeoff

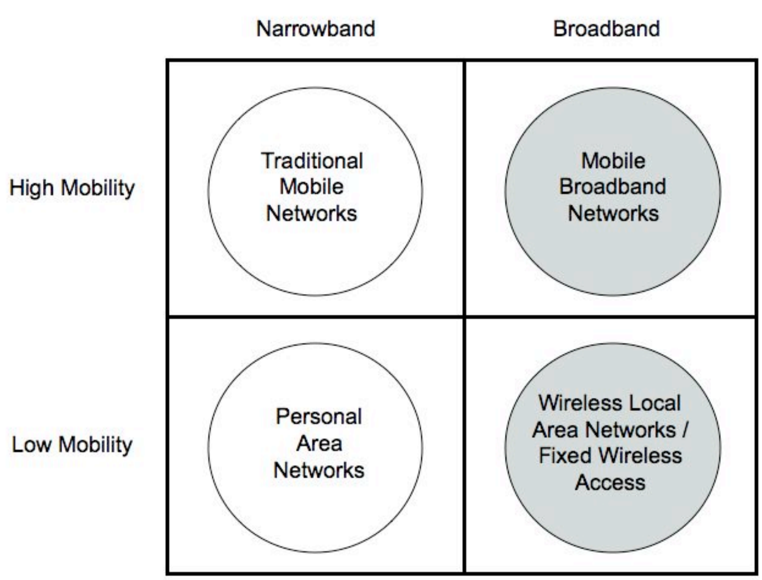

Figure 5. Wireless Startup Technology Space 1990-2009

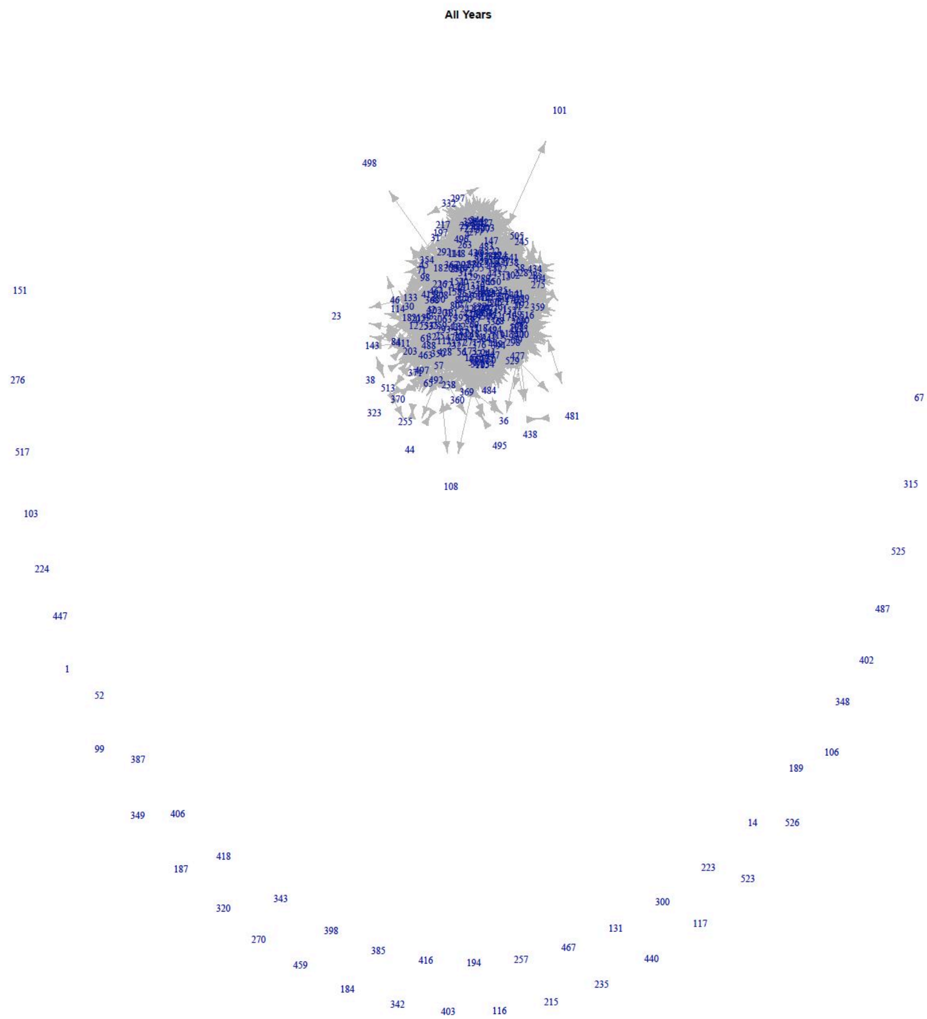

Table 1. Variable Definitions

Variable Name	Description
Dependent Variables	
Failure	A Dummy indicating that the firm had experienced a distressed sale or had become defunct
Success	A Dummy indicating that the firm had experienced a trade sale or IPO
Independent Variables	
Patent Grant Flow	Number of new patents granted to the firm at time t
Closeness centrality in startup technology space	Closeness centrality of the firm in the network defined through shared IPC
Patent Cite Flow by Firms	Number of new cites received from other organizations by firm at time t
Concentration of Fw Cite Flow	A measure of concentration of the forward cites by IPC classes
Control Variables	
IPR related	
Total Patent Cite Flow	Total number of new cites received by firm at time t
Patent Grant Stock at t-1	Stock of firms patent at time t-1
Total Fw Cite Stock at t-1	Stock of forward cites received by firm at t-1
Exit Market Conditions	
ipoheat	the intensity of IPO activity in the startups primary SIC code
Number of Targets in SIC	Number of targets acquired in the SIC in a given year
Investor Characteristics	
Total Number of Investors	Number of distinct investors that invested in company over all rounds
Num of Investors investing in all rounds	Number of investors that invest in all rounds
Number of Corporate VCs	Number of CVC's in the firm
Financing Related	
Number of Rounds Received	Number of rounds of funding received by the company till end of study
Time to First Round	Time in days from founding to receive first round
Firm Strategic Action	
Number of Alliances	Number of alliances by firmat time t
Number of Acquisitions	Number of acquisitions made by the firm
Others	
Biz Seg Sales in Wireless	Total sales of all public wireless companies in a given SIC code
entryyear	Year of entry of firm in risk set

Table 2. Summary Statistics and Correlations

		Mean	S.D.	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	Failure	0.23	0.42	0	1	1							
(2)	Success	0.3	0.46	0	1	-0.354	1						
(3)	Patent Grant Flow	0.98	3.14	0	41	-0.017	-0.015	1					
(4)	Closeness centrality in startup technology space	0.01	0.01	0	0.02	-0.125	-0.001	0.223	1				
(5)	Total Patent Cite Flow	3.92	13.35	0	190	0.001	-0.005	0.526	0.216	1			
(6)	Patent Cite Flow by Firms	3.59	11.66	0	158	0.01	0.003	0.527	0.224	0.988	1		
(7)	Concentration of Fw Cite Flow	0.12	0.22	0	1	-0.022	-0.023	0.168	0.287	0.173	0.184	1	
(8)	Patent Grant Stock at t-1	2.69	8.83	0	112	-0.05	-0.075	0.414	0.213	0.602	0.586	0.218	1
(9)	Total Fw Cite Stock at t-1	12.36	64.76	0	1364	-0.047	-0.057	0.216	0.139	0.593	0.561	0.127	0.764
(10)	ipoheat	0.04	0.05	0	0.28	0.013	0.192	-0.057	0	-0.058	-0.058	-0.005	-0.067
(11)	Number of Targets in SIC	125.85	186.67	0	662	-0.076	0.227	-0.037	0.025	-0.029	-0.026	0.047	-0.052
(12)	Total Number of Investors	6.11	4.72	1	29	-0.067	0.07	0.165	0.249	0.247	0.268	0.167	0.218
(13)	Number of Rounds Received	4.28	3.02	1	20	-0.1	0.042	0.063	0.123	0.11	0.126	0.135	0.118
(14)	Time to First Round	680.27	769.08	0	4496	0.001	0.016	-0.049	-0.074	-0.018	-0.036	-0.078	-0.016
(15)	Num of Investors investing in all rounds	0.92	1	0	8	0.081	-0.078	-0.045	-0.091	-0.052	-0.055	-0.068	-0.079
(16)	Number of Corporate VCs	0.86	1.23	0	9	-0.048	0.061	0.168	0.289	0.183	0.202	0.166	0.172
(17)	Number of Alliances	0.34	0.94	0	13	-0.099	0.009	0.089	0.089	0.109	0.116	0.144	0.121
(18)	Number of Acquisitions	0.37	1.04	0	8	-0.12	0.176	-0.016	-0.023	0.021	0.027	0.073	-0.009
(19)	Biz Seg Sales in Wireless	1.89E+06	3.24E+06	0	1.06E+07	-0.043	0.126	0.099	0.095	0.154	0.158	0.035	0.099
(20)	entryyear	1999.19	3.89	1990	2009	-0.217	-0.232	-0.02	0.057	-0.146	-0.143	-0.034	-0.087

		(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1)	Failure												
(2)	Success												
(3)	Patent Grant Flow												
(4)	Closeness centrality in startup technology space												
(5)	Total Patent Cite Flow												
(6)	Patent Cite Flow by Firms												
(7)	Concentration of Fw Cite Flow												
(8)	Patent Grant Stock at t-1												
(9)	Total Fw Cite Stock at t-1	1											
(10)	ipoheat	-0.052	1										
(11)	Number of Targets in SIC	-0.038	0.752	1									
(12)	Total Number of Investors	0.192	0.096	0.058	1								
(13)	Number of Rounds Received	0.082	0.037	0.017	0.685	1							
(14)	Time to First Round	0.032	-0.029	-0.077	-0.209	-0.195	1						
(15)	Num of Investors investing in all rounds	-0.057	-0.018	0.02	-0.286	-0.45	0.004	1					
(16)	Number of Corporate VCs	0.118	0.097	0.089	0.622	0.351	-0.117	-0.158	1				
(17)	Number of Alliances	0.116	0.056	0.149	0.17	0.087	-0.099	-0.019	0.186	1			
(18)	Number of Acquisitions	0.026	0.033	0.032	0.269	0.222	-0.036	-0.171	0.098	0.035	1		
(19)	Biz Seg Sales in Wireless	0.093	-0.204	-0.222	0.124	0.123	-0.005	-0.068	0.01	-0.001	0.057	1	
(20)	entryyear	-0.135	-0.069	0.096	-0.258	-0.228	-0.444	0.259	-0.118	0.058	-0.151	-0.148	1

Table 3a. Cox Proportional Hazard Competing Risk Model - Failure

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Patent Grant Flow	-0.0622	-0.0502	-0.106**	-0.0976**	-0.0976**	-0.342***	-0.369***
	(0.0422)	(0.0400)	(0.0490)	(0.0482)	(0.0486)	(0.104)	(0.109)
Closeness centrality in startup technology space		-26.99**	-28.69**	-30.62***	-35.19***	-29.62**	-32.44***
		(11.31)	(11.33)	(11.51)	(12.13)	(12.06)	(12.09)
Total Patent Cite Flow			0.0234***	-0.0690	-0.0684	-0.253**	-0.321**
			(0.00825)	(0.0629)	(0.0630)	(0.115)	(0.127)
Patent Cite Flow by Firms				0.102	0.102	0.295**	0.424***
				(0.0651)	(0.0653)	(0.122)	(0.143)
Concentration of Fw Cite Flow					0.618	0.680	1.219***
					(0.452)	(0.446)	(0.469)
Patent Grant Flow Square						0.00909***	0.00956***
						(0.00289)	(0.00307)
Patent Cite Flowby Firm X Concentration							-0.309**
							(0.147)
Patent Grant Stock at t-1	0.0263**	0.0280**	0.0248*	0.0307**	0.0292**	0.0350**	0.0417***
	(0.0122)	(0.0120)	(0.0127)	(0.0129)	(0.0132)	(0.0137)	(0.0137)
Total Fw Cite Stock at t-1	-0.00181	-0.00107	-0.00394	-0.00474	-0.00482	-0.00435	-0.00608
	(0.00254)	(0.00245)	(0.00308)	(0.00386)	(0.00395)	(0.00421)	(0.00442)
ipoheat	-14.96***	-15.18***	-14.58***	-14.57***	-14.86***	-14.67***	-14.79***
	(4.872)	(4.878)	(4.872)	(4.870)	(4.899)	(4.922)	(4.870)
Number of Targets in SIC	0.00196**	0.00204**	0.00200**	0.00199**	0.00199**	0.00194**	0.00191**
	(0.000894)	(0.000894)	(0.000899)	(0.000897)	(0.000898)	(0.000906)	(0.000893)
Total Number of Investors	-0.0162	-0.00615	-0.0192	-0.0231	-0.0223	-0.0173	0.00504
	(0.0436)	(0.0438)	(0.0438)	(0.0432)	(0.0432)	(0.0426)	(0.0457)
Number of Rounds Received	-0.177***	-0.184***	-0.180***	-0.183***	-0.189***	-0.186***	-0.211***
	(0.0639)	(0.0637)	(0.0629)	(0.0626)	(0.0632)	(0.0631)	(0.0660)
Time to First Round	-0.00111***	-0.00108***	-0.00107***	-0.00105***	-0.00104***	-0.00103***	-0.00105***
	(0.000206)	(0.000208)	(0.000206)	(0.000205)	(0.000205)	(0.000203)	(0.000208)
Num of Investors investing in all rounds	0.120	0.0914	0.0803	0.0745	0.0675	0.0723	0.0606
	(0.102)	(0.103)	(0.104)	(0.105)	(0.105)	(0.105)	(0.103)
Number of Corporate VCs	-0.00728	0.0262	0.0124	0.00586	0.00389	-7.50e-05	0.0342
	(0.116)	(0.117)	(0.118)	(0.117)	(0.118)	(0.120)	(0.114)
Number of Alliances	-0.885***	-0.864***	-0.876***	-0.886***	-0.887***	-0.859***	-0.881***
	(0.308)	(0.306)	(0.308)	(0.307)	(0.306)	(0.302)	(0.302)
Number of Acquisitions	-0.612**	-0.631**	-0.607**	-0.623**	-0.650**	-0.674**	-0.653**
	(0.254)	(0.253)	(0.250)	(0.254)	(0.259)	(0.262)	(0.260)
Biz Seg Sales in Wireless	-6.37e-09	7.61e-09	9.19e-09	8.41e-09	9.70e-09	1.20e-08	4.42e-09
	(3.07e-08)	(3.15e-08)	(3.16e-08)	(3.15e-08)	(3.15e-08)	(3.19e-08)	(3.23e-08)
entryyear	-0.159***	-0.139***	-0.129***	-0.130***	-0.129***	-0.129***	-0.131***
	(0.0344)	(0.0343)	(0.0347)	(0.0346)	(0.0348)	(0.0348)	(0.0352)
Observations	2958	2958	2958	2958	2958	2958	2958
Number of Events	109	109	109	109	109	109	109
Log Likelihood	-353.32941	-350.43675	-346.75345	-344.32711	-343.47459	-338.4985	-334.43986

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in parentheses

Table 3b. Cox Proportional Hazard Competing Risk Model - Success

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Patent Grant Flow	0.0198	0.0212	0.00124	0.00155	0.000934	0.157**	0.175**
	(0.0231)	(0.0230)	(0.0284)	(0.0285)	(0.0284)	(0.0701)	(0.0719)
Closeness centrality in startup technology space		-6.489	-7.035	-7.655	-5.027	-9.947	-12.10
		(10.35)	(10.35)	(10.42)	(10.80)	(11.11)	(11.19)
Total Patent Cite Flow			0.0112	-0.0143	-0.0156	-0.00401	-0.00256
			(0.00797)	(0.0460)	(0.0462)	(0.0368)	(0.0391)
Patent Cite Flow by Firms				0.0289	0.0302	0.0187	0.0412
				(0.0507)	(0.0509)	(0.0410)	(0.0456)
Concentration of Fw Cite Flow					-0.368	-0.470	-0.103
					(0.433)	(0.445)	(0.468)
Patent Grant Flow Square						-0.00738*	-0.00834**
						(0.00392)	(0.00409)
Patent Cite Flowby Firm X Concentration							-0.127*
							(0.0730)
Patent Grant Stock at t-1	0.00698	0.00765	0.00577	0.00587	0.00690	0.00338	-0.00111
	(0.0131)	(0.0130)	(0.0138)	(0.0140)	(0.0139)	(0.0141)	(0.0154)
Total Fw Cite Stock at t-1	-0.00254	-0.00243	-0.00420	-0.00399	-0.00392	-0.00423	-0.00340
	(0.00229)	(0.00224)	(0.00282)	(0.00296)	(0.00290)	(0.00299)	(0.00283)
ipoheat	-4.076	-4.084	-3.876	-3.847	-3.767	-3.468	-3.663
	(2.749)	(2.746)	(2.752)	(2.754)	(2.745)	(2.730)	(2.747)
Number of Targets in SIC	0.00362***	0.00364***	0.00358***	0.00358***	0.00360***	0.00360***	0.00359***
	(0.000652)	(0.000653)	(0.000653)	(0.000653)	(0.000652)	(0.000650)	(0.000649)
Total Number of Investors	-0.0264	-0.0254	-0.0287	-0.0304	-0.0327	-0.0384	-0.0342
	(0.0332)	(0.0332)	(0.0333)	(0.0333)	(0.0334)	(0.0335)	(0.0341)
Number of Rounds Received	-0.149***	-0.150***	-0.149***	-0.149***	-0.146***	-0.149***	-0.149***
	(0.0520)	(0.0518)	(0.0516)	(0.0515)	(0.0514)	(0.0515)	(0.0513)
Time to First Round	-0.00102***	-0.00101***	-0.00101***	-0.00100***	-0.00102***	-0.00105***	-0.00105***
	(0.000179)	(0.000179)	(0.000179)	(0.000179)	(0.000180)	(0.000182)	(0.000182)
Num of Investors investing in all rounds	0.00823	0.00384	-0.00491	-0.00922	-0.00356	0.00178	-0.000488
	(0.102)	(0.102)	(0.103)	(0.103)	(0.103)	(0.103)	(0.103)
Number of Corporate VCs	0.0613	0.0756	0.0773	0.0744	0.0787	0.0713	0.0784
	(0.0900)	(0.0930)	(0.0930)	(0.0930)	(0.0931)	(0.0937)	(0.0943)
Number of Alliances	-0.187*	-0.189*	-0.194*	-0.194*	-0.186	-0.199*	-0.221*
	(0.112)	(0.112)	(0.113)	(0.113)	(0.113)	(0.114)	(0.116)
Number of Acquisitions	0.185***	0.180***	0.184***	0.184***	0.194***	0.211***	0.212***
	(0.0664)	(0.0669)	(0.0670)	(0.0670)	(0.0677)	(0.0679)	(0.0683)
Biz Seg Sales in Wireless	1.06e-07***	1.09e-07***	1.08e-07***	1.08e-07***	1.07e-07***	1.06e-07***	1.06e-07***
	(2.71e-08)	(2.76e-08)	(2.76e-08)	(2.76e-08)	(2.76e-08)	(2.76e-08)	(2.77e-08)
entryyear	-0.0965***	-0.0926***	-0.0845**	-0.0841**	-0.0862**	-0.0889**	-0.0861**
	(0.0354)	(0.0357)	(0.0363)	(0.0363)	(0.0363)	(0.0364)	(0.0365)
Observations	2958	2958	2958	2958	2958	2958	2958
Number of Events	135	135	135	135	135	135	135
Log Likelihood	-425.94823	-425.75229	-424.8079	-424.62835	-424.25072	-420.46316	-418.54195

*** p<0.01, ** p<0.05, * p<0.1

Standard errors in parentheses

REFERENCES

Acs, Z. & Audretsch, D. 1989. Births and firm size. ***Southern Economic Journal***, 56(2): 467-475.

Agarwal, R., Sarkar, M., & Echamebadi, R. 2002. The conditioning effect of time on firm survival: An industry life cycle approach. ***Academy of Management Journal***, 45(5): 971-994.

Allison, P. 1984. ***Event history analysis: Regression for longitudinal event data***: Sage Beverly Hills, CA.

Anderson, P. & Tushman, M. 2001. Organizational environments and industry exit: The effects of uncertainty, munificence and complexity. ***Industrial and Corporate Change***, 10(3): 675.

Arora, A., Fosfuri, A., & Gambardella, A. 2004. ***Markets for technology: The economics of innovation and corporate strategy***: The MIT Press.

Audretsch, D. B. 1991. New-Firm Survival and the Technological Regime. ***The Review of Economics and Statistics***, 73(3): 441-450.

Barney, J. 1991. Firm resources and sustainable competitive advantage. ***Journal of management***, 17(1): 99-120.

Baron, J., Burton, M., & Hannan, M. 1996. The road taken: Origins and evolution of employment systems in emerging companies. ***Industrial and Corporate Change***, 5(2): 239.

Baron, J., Burton, M., & Hannan, M. 1999. Engineering bureaucracy: The genesis of formal policies, positions, and structures in high-technology firms. ***Journal of Law, Economics, and Organization***, 15(1): 1.

Baron, J., Hannan, M., & Burton, M. 1999a. Building the iron cage: Determinants of managerial intensity in the early years of organizations. ***American Sociological Review***, 64(4): 527-547.

Baron, J., Hannan, M., & Burton, M. 2001. Labor Pains: Change in Organizational Models and Employee Turnover in Young, High-Tech Firms 1. ***American Journal of Sociology***, 106(4): 960-1012.

Baron, J. N., Hannan, M. T., & Burton, M. D. 1999b. Building the Iron Cage: Determinants of Managerial Intensity in the Early Years of Organizations. ***American Sociological Review***, 64(4): 527-547.

Baum, J. A. C. & Oliver, C. 1991. Institutional Linkages and Organizational Mortality. ***Administrative Science Quarterly***, 36(2): 187-218.

Baum, J. A. C. & Oliver, C. 1996. Toward an institutional ecology of organizational founding. ***Academy of Management Journal***, 39(5): 1378-1427.

Baum, J. A. C., Calabrese, T., & Silverman, B. S. 2000. Don't go it alone: Alliance network composition and startups' performance in Canadian biotechnology. ***Strategic Management Journal***, 21(3): 267-294.

Baum, J. A. C. & Silverman, B. S. 2004. Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology startups. ***Journal of Business Venturing***, 19(3): 411-436.

Bayus, B. L. & Agarwal, R. 2007. The role of pre-entry experience, entry timing, and product technology strategies in explaining firm survival. ***Management Science***, 53(12): 1887-1902.

Beckman, C. 2006. The influence of founding team company affiliations on firm behavior. ***Academy of Management Journal***, 49(4): 741.

Bhide, A. 1994. How Entrepreneurs Craft Strategies That Work. ***Harvard Business Review***, 72(2): 150-161.

Boeker, W. 1989. Strategic change: The effects of founding and history. ***Academy of Management Journal***: 489-515.

Boeker, W. & Karichalil, R. 2002. Entrepreneurial transitions: Factors influencing founder departure. ***Academy of Management Journal***: 818-826.

Bourgeois, L. & Eisenhardt, K. 1987. Strategic decision processes in Silicon Valley: The anatomy of a'living dead. ***California Management Review***, 30(1): 143-159.

Breschi, S., Malerba, F., & Orsenigo, L. 2000. Technological Regimes and Schumpeterian Patterns of Innovation. ***The Economic Journal***, 110(463): 388-410.

Bresnahan, T. & Trajtenberg, M. 1995. General purpose technologies' Engines of growth'? ***Journal of Econometrics***, 65(1): 83-108.

Brüderl, J. & Schüssler, R. 1990. Organizational Mortality: The Liabilities of Newness and Adolescence. ***Administrative Science Quarterly***, 35(3): 530-547.

Brüderl, J., Preisendörfer, P., & Ziegler, R. 1992. Survival chances of newly founded business organizations. ***American Sociological Review***: 227-242.

Burton, M., Sorensen, J., & Beckman, C. 2002. Coming from good stock: Career histories and new venture formation. ***Research in the Sociology of Organizations***, 19: 229-262.

Camponovo, G. & Pigneur, Y. 2003. Analyzing the m-business landscape. ***Annals of Telecommunications***, 58(1): 59-77.

Carroll, G., Bigelow, L., Seidel, M., & Tsai, L. 1996. The fates of de novo and de alio producers in the American automobile industry 1885-1981. ***Strategic Management Journal***, 17: 117-137.

Caves, R. 1980. Industrial organization, corporate strategy and structure. ***Journal of economic literature***: 64-92.

Caves, R. E. & Porter, M. E. 1977. From Entry Barriers to Mobility Barriers: Conjectural Decisions and Contrived Deterrence to New Competition*. ***The Quarterly Journal of Economics***, 91(2): 241-261.

Chandler, A. 1962. Strategy and structure: Chapters in the history of American enterprise. ***Massachusetts Institute of Technology Cambridge***.

Christensen, C. & Bower, J. 1996. Customer power, strategic investment, and the failure of leading firms. ***Strategic Management Journal***, 17(3): 197-218.

Cohen, W. & Levinthal, D. 1989. Innovation and learning: the two faces of R & D. ***The Economic Journal***: 569-596.

Cohen, W. & Levinthal, D. 1990. Absorptive capacity: a new perspective on learning and innovation. ***Administrative Science Quarterly***, 35(1).

Cohen, W., Nelson, R., & Walsh, J. 2000. ***Protecting their intellectual assets: Appropriability conditions and why US manufacturing firms patent (or not)***: National Bureau of Economic Research Cambridge, Mass., USA.

Corley, K. & Gioia, D. 2004. Identity ambiguity and change in the wake of a corporate spin-off. ***Administrative Science Quarterly***, 49(2): 173-208.

Corredoira, R. A. & Rosenkopf, L. 2010. Should auld acquaintance be forgot? the reverse transfer of knowledge through mobility ties. ***Strategic Management Journal***, 31(2): 159-181.

Cusumano, M., Mylonadis, Y., & Rosenbloom, R. 1992. Strategic maneuvering and mass-market dynamics: The triumph of VHS over Beta. ***The Business History Review***, 66(1): 51-94.

Delacroix, J. & Carroll, G. R. 1983. Organizational Foundings: An Ecological Study of the Newspaper Industries of Argentina and Ireland. ***Administrative Science Quarterly***, 28(2): 274-291.

Dosi, G. 1982. Technological paradigms and technological trajectories:: A suggested interpretation of the determinants and directions of technical change. ***Research Policy***, 11(3): 147-162.

Dowell, G. & Swaminathan, A. 2006. Entry timing, exploration, and firm survival in the early US bicycle industry. ***Strategic Management Journal***, 27(12): 1159-1182.

Eggers, J. 2008. Falling flat: Failed technologies and behavioral path dependence. ***Unpublished working paper, New York University, New York, NY***.

Eisenhardt, K. M. & Schoonhoven, C. B. 1990. Organizational Growth: Linking Founding Team, Strategy, Environment, and Growth Among U.S. Semiconductor Ventures, 1978-1988. ***Administrative Science Quarterly***, 35(3): 504-529.

Eisenhardt, K. M. & Martin, J. A. 2000. Dynamic capabilities: What are they? ***Strategic Management Journal***, 21(10-11): 1105-1121.

Fiss, P. 2010. Building better causal theories: A fuzzy set approach to typologies in organization research. ***Working Paper***.

Gans, J. S., Hsu, D. H., & Stern, S. 2002. When Does Start-Up Innovation Spur the Gale of Creative Destruction? ***The RAND Journal of Economics***, 33(4): 571-586.

Gilbert, B., Audretsch, D., & McDougall, P. 2004. The emergence of entrepreneurship policy. ***Small Business Economics***, 22(3): 313-323.

Gimeno, J., Folta, T., Cooper, A., & Woo, C. 1997. Survival of the fittest? Entrepreneurial human capital and the persistence of underperforming firms. ***Administrative Science Quarterly***: 750-783.

Giot, P. & Schwienbacher, A. 2007. IPOs, trade sales and liquidations: modelling venture capital exits using survival analysis. ***Journal of Banking and Finance***, 31(3): 679-702.

Gompers, P. & Lerner, J. 2004. ***The venture capital cycle***: The MIT Press.

Gompers, P., Kovner, A., Lerner, J., Scharfstein, D., & Field, S. 2006. Skill vs. luck in entrepreneurship and venture capital: Evidence from serial entrepreneurs. ***Working Paper***.

Groysberg, B., Nanda, A., & Nohria, N. 2004. The risky business of hiring stars. ***Harvard Business Review***, 82(5): 92-101.

Gulati, R. & Higgins, M. C. 2003. Which ties matter when? The contingent effects of interorganizational partnerships on IPO success. ***Strategic Management Journal***, 24(2): 127-144.

Hall, B. & Trajtenberg, M. 2004. ***Uncovering GPTs with patent data***: National Bureau of Economic Research Cambridge, Mass., USA.

Hannan, M. & Freeman, J. 1984. Structural inertia and organizational change. ***American Sociological Review***, 49(2): 149-164.

Hannan, M., Burton, M., & Baron, J. 1996. Inertia and change in the early years: Employment relations in young, high technology firms. ***Industrial and Corporate Change***, 5(2): 503.

Hannan, M., Pólos, L., & Carroll, G. 2007. ***Logics of organization theory: Audiences, codes, and ecologies***: Princeton Univ Pr.

Hannan, M. 2008. ***Partiality: Categories and niches***.

Hellman, T. & Puri, M. 2000. The interaction between product market and financing strategy: the role of venture capital. ***Rev. Financ. Stud.***, 13(4): 959-984.

Hellmann, T. & Puri, M. 2002. Venture Capital and the Professionalization of Start-up Firms: Empirical Evidence. ***The Journal of Finance***, 57(1): 169-197.

Helpman, E. 1998. ***General purpose technologies and economic growth***: The MIT Press.

Henderson, R. & Clark, K. 1990. Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. ***Administrative Science Quarterly***, 35(1).

Henderson, R. & Cockburn, I. 1994. Measuring competence? Exploring firm effects in pharmaceutical research. ***Strategic Management Journal***, 15: 63-84.

Hsu, D. 2004. What do entrepreneurs pay for venture capital affiliation? ***The Journal of Finance***, 59(4): 1805-1844.

Hsu, D. 2007. Experienced entrepreneurial founders, organizational capital, and venture capital funding. ***Research Policy***, 36(5): 722-741.

Hsu, D. & Lim, K. 2008. The Antecedents and Innovation Consequences of Organizational Knowledge Brokering Capability. ***Working Paper***.

Hsu, D. H. 2006a. Venture capitalists and cooperative start-up commercialization strategy. ***Management Science***, 52(2): 204-219.

Hsu, D. H. & Ziedonis, R. 2008. Patents as quality signals for entrepreneurial ventures. ***Working Paper***.

Hsu, G. & Hannan, M. 2005. Identities, Genres, and Organizational Forms. ***Organization Science***, 16(5): 474.

Hsu, G. 2006b. Jacks of All Trades and Masters of None: Audiences' Reactions to Spanning Genres in Feature Film Production. ***Administrative Science Quarterly***, 51(3): 420-450.

Hsu, G., Hannan, M., & Pólos, L. 2008. Typecasting and Legitimation: A Formal Theory.

Jacobides, M. G., Knudsen, T., & Augier, M. 2006. Benefiting from innovation: Value creation, value appropriation and the role of industry architectures. ***Research Policy***, 35(8): 1200-1221.

Jaffe, A. B., Trajtenberg, M., & Henderson, R. 1993. Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. ***The Quarterly Journal of Economics***, 108(3): 577-598.

Jensen, M. & Meckling, W. 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. ***Journal of Financial Economics***, 3(4): 305-360.

Jovanovic, B. & MacDonald, G. 1994. The life cycle of a competitive industry. ***The Journal of Political Economy***, 102(2): 322-347.

Kahneman, D. & Tversky, A. 1979. Prospect theory: An analysis of decision under risk. ***Econometrica***, 47(2): 263-291.

Kaplan, S. & Strömberg, P. 2004. Characteristics, contracts, and actions: Evidence from venture capitalist analyses. ***Journal of Finance***: 2177-2210.

Klepper, S. & Graddy, E. 1990. The evolution of new industries and the determinants of market structure. ***The RAND Journal of Economics***, 21(1): 27-44.

Klepper, S. & Simons, K. L. 2000. Dominance by birthright: Entry of prior radio producers and competitive ramifications in the US television receiver industry. ***Strategic Management Journal***, 21(10-11): 997-1016.

Klepper, S. 2002. The capabilities of new firms and the evolution of the US automobile industry. ***Industrial and Corporate Change***, 11(4): 645.

Kuilman, J. & Wezel, F. C. 2010. Reaching consensus? Name extensions and organizational mortality in the U.K. passenger airline industry. ***Working Paper***.

Lee, C., Lee, K., & Pennings, J. M. 2001. Internal capabilities, external networks, and performance: A study on technology-based ventures. ***Strategic Management Journal***, 22(6-7): 615-640.

Lee, E. & Wang, J. 2003. ***Statistical methods for survival data analysis***: Wiley-Interscience.

Levin, R., Klevorick, A., Nelson, R., Winter, S., Gilbert, R., & Griliches, Z. 1987. Appropriating the returns from industrial research and development. ***Brookings papers on economic activity***, 1987(3): 783-831.

Levinthal, D. & Wu, B. 2007. Opportunity Costs and Non-Scale Free Capabilities: Profit Maximization, Corporate Scope, and Profit Margins. ***Working Paper***.

Lieberson, S. 1987. ***Making it count: The improvement of social research and theory***: Univ of California Press.

Litvak, I. & Maule, C. 1980. Entrepreneurial success or failure-ten years later. ***Business Quarterly***, 45(4): 68.

Lounsbury, M. & Glynn, M. 2001. Cultural entrepreneurship: Stories, legitimacy, and the acquisition of resources. ***Strategic Management Journal***: 545-564.

Marx, M., Strumsky, D., & Fleming, L. 2009. Mobility, Skills, and the Michigan Non-Compete Experiment. ***Management Science***, 55(6): 875-889.

Megginson, W. L. & Weiss, K. A. 1991. Venture Capitalist Certification in Initial Public Offerings. ***The Journal of Finance***, 46(3): 879-903.

Meyer, M. & Zucker, L. 1989. ***Permanently failing organizations***: Sage Publications, Inc.

Mowery, D. C., Oxley, J. E., & Silverman, B. S. 1996. Strategic alliances and interfirm knowledge transfer. ***Strategic Management Journal***, 17: 77-91.

Negro, G., Hannan, M., & Rao, H. 2008. ***Categorical contrast and audience appeal: niche width and critical success in winemaking***.

Nelson, R. & Winter, S. 1982. ***An evolutionary theory of economic change***: Belknap Press.

Nerkar, A. & Shane, S. 2003. When do start-ups that exploit patented academic knowledge survive? ***International Journal of Industrial Organization***, 21(9): 1391-1410.

Penrose, E. 1995. ***The Theory of the Growth of the Firm***: Oxford: Oxford University Press.

Peteraf, M. 1993. The cornerstones of competitive advantage: a resource-based view. ***Strategic Management Journal***, 14(3): 179-191.

Phillips, D. 2002. A Genealogical Approach to Organizational Life Chances: The Parent-Progeny Transfer among Silicon Valley Law Firms, 1946-1996. ***Administrative Science Quarterly***, 47(3): 474-508.

Podolny, J. & Stuart, T. 1995. A role-based ecology of technological change. ***The American Journal of Sociology***, 100(5): 1224-1260.

Podolny, J., Stuart, T., & Hannan, M. 1996. Networks, knowledge, and niches: Competition in the worldwide semiconductor industry, 1984-1991. ***American Journal of Sociology***: 659-689.

Podolny, J. 2005. ***Status signals: A sociological study of market competition***: Princeton Univ Pr.

Pontikes, E. 2009. Fitting in or starting new? An analysis of invention, constraint, and the emergence of new categories in the software industry. ***Working Paper***.

Porter, M. 1980. ***Competitive strategy: techniques for analyzing industries and competitors: with a new introduction***: Free Press.

Ragin, C. 2008. ***Redesigning social inquiry: Fuzzy sets and beyond***: University of Chicago Press.

Romanelli, E. 1989. Environments and Strategies of Organization Start-Up: Effects on Early Survival. ***Administrative Science Quarterly***, 34(3): 369-387.

Rosenkopf, L. & Nerkar, A. 2001. Beyond local search: Boundary-spanning, exploration, and impact in the optical disk industry. ***Strategic Management Journal***, 22(4): 287-306.

Rosenkopf, L. & Almeida, P. 2003. Overcoming local search through alliances and mobility. ***Management Science***, 49(6): 751-766.

Rothaermel, F. & Thursby, M. 2005. Incubator firm failure or graduation? The role of university linkages. ***Research Policy***, 34(7): 1076-1090.

Ruef, M. & Patterson, K. 2009. Credit and Classification: The Impact of Industry Boundaries in Nineteenth-century America. ***Administrative Science Quarterly***, 54(3): 486-520.

Ruhnka, J., Feldman, H., & Dean, T. 1992. The" living dead" phenomenon in venture capital investments. ***Journal of Business Venturing***, 7(2): 137-155.

Schlesselman, J. & Stolley, P. 1982. ***Case control studies: design, conduct, analysis***: Oxford University Press, USA.

Shane, S. 2001a. Technology regimes and new firm formation. ***Management Science***, 47(9): 1173-1190.

Shane, S. 2001b. Technological opportunities and new firm creation. ***Management Science***, 47(2): 205-220.

Shane, S. 2002. Selling university technology: Patterns from MIT. ***Management Science***, 48(1): 122-137.

Shane, S. & Stuart, T. 2002. Organizational endowments and the performance of university start-ups. ***Management Science***: 154-170.

Smith, E. 2010a. Intermediaries, Mediators, and Market Change in the Hedge Fund Industry. ***Working Paper***.

Smith, E. 2010b. Amplified Interfaces: How Organizational Identity Affects Investor Reaction to Market Performance. ***Working Paper***.

Spence, M. 1973. Job Market Signaling. ***The Quarterly Journal of Economics***, 87(3): 355-374.

Staw, B. M., Sandelands, L. E., & Dutton, J. E. 1981. Threat Rigidity Effects in Organizational Behavior: A Multilevel Analysis. ***Administrative Science Quarterly***, 26(4): 501-524.

Stinchcombe, A. 1965. Social structure and organizations. ***March (1965)***: 142-193.

Stuart, T. & Podolny, J. 1996. Local search and the evolution of technological capabilities. ***Strategic Management Journal***, 17: 21-38.

Stuart, T. E. 1998. Network positions and propensities to collaborate: An investigation of strategic alliance formation in a high-technology industry. ***Administrative Science Quarterly***, 43(3): 668-698.

Stuart, T. E., Hoang, H., & Hybels, R. C. 1999. Interorganizational endorsements and the performance of entrepreneurial ventures. ***Administrative Science Quarterly***, 44(2): 315-349.

Suarez, F. F. & Utterback, J. M. 1995. Dominant Designs and the Survival of Firms. ***Strategic Management Journal***, 16(6): 415-430.

Teece, D. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. ***Research Policy***, 15(6): 285-305.

Teece, D., Pisano, G., & Shuen, A. 1997. Dynamic capabilities and strategic management. ***Strategic Management Journal***, 18(7): 509-533.

Tushman, M. & Anderson, P. 1986. Technological discontinuities and organizational environments. ***Administrative Science Quarterly***: 439-465.

Utterback, J. 1995. Dominant designs and the survival of firms. ***Strategic Management Journal***, 16(6): 415-430.

Van de Ven, A. & Garud, R. 1994. The coevolution of technical and institutional events in the development of an innovation. ***Evolutionary dynamics of organizations***: 425-443.

Wernerfelt, B. 1984. A resource-based view of the firm. ***Strategic Management Journal***: 171-180.

Winter, S. 2003. Understanding dynamic capabilities. ***Strategic Management Journal***, 24(10): 991-995.

Zucker, L., Darby, M., & Armstrong, J. 1998. Geographically localized knowledge: spillovers or markets? ***Economic Inquiry***, 36(1): 65-86.

Zuckerman, E. 1999. The categorical imperative: Securities analysts and the illegitimacy discount. ***American Journal of Sociology***, 104(5): 1398-1438.